

## REMARKS

Claims 1-28, 33-36, 38-47, 51, 52, and 63-66 are pending in the present application. Claim 37 has been canceled. Claim 33 has been amended. Support for amended Claim 33 can be found in the Application, for example in paragraphs [0052] – [0054] and FIG. 6. No new matter has been added. Applicants respectfully request entry of the amendments and reconsideration of the application in view of the following remarks.

### Allowable Subject Matter

Claims 1-28 have been allowed. Applicants sincerely thank the Examiner for allowable subject matter.

### Rejection Under 35 U.S.C. 103(a)

Claims 33-37, 44-45, 52 and 63-66 have been rejected as unpatentable over Soininen et al. (U.S. Patent No. 6,482,740) in view of Wu et al. (U.S. 2005/0110147). Claims 46-47 have been rejected as unpatentable over Soininen et al. and Wu et al., and further in view of Elers et al. (WO 01/29893). Claims 38-43 have been rejected as unpatentable over Soininen et al. and Wu et al., and further in view of Aaltonen et al. (U.S. 2003/0165615). Claim 51 was rejected as unpatentable over Soininen et al. and Wu et al. and further in view of Chen et al. (U.S. Patent No. 6,753,249). These rejections are traversed.

### Independent Claim 33

Applicants respectfully submit that a *prima facie* case of obviousness has not been established, because the cited references, considered alone or in any combination, fail to disclose all the claim limitations. M.P.E.P. § 2143. In particular, Applicants submit that the cited art fails to disclose a method for metallizing an integrated circuit comprising, *inter alia*, “exposing the diffusion barrier layer to an oxidant and a reducing agent” and “depositing a conductor over the nucleation layer to form a seed layer that is different from the nucleation layer.”

The cited art fails to disclose “exposing the diffusion barrier layer to an oxidant and a reducing agent”

First, Applicants submit that the cited art fails to disclose “exposing the diffusion barrier layer to an oxidant and a reducing agent,” as recited in Claim 33. The Office Action on p. 3 refers to “cobalt oxide” in Soininen et al. as disclosing the claimed oxidant, and “nitrogen gas” in Soininen et al. as disclosing the claimed reducing agent. Applicants respectfully disagree with this characterization.

Soininen et al. teaches that a metal oxide (e.g., ‘cobalt oxide’) is first *deposited* by ALD *over* diffusion layer 14 from alternating pulses of a metal source chemical and an oxygen source chemical, thus disclosing at best, that *diffusion layer* 14 may be exposed to an *oxidant*. (Col. 7, lines 26-29; Col. 10, lines 12-13). Soininen et al. further teaches that the ALD-grown metal oxide is subsequently reduced into metal layer 16. (Col. 7, lines 35-37). However, Soininen et al. specifies that reduction occurs only *after* the metal oxide is grown to a “thickness sufficient for seed layer purposes.” (Col. 7, lines 33-35). Accordingly, it is not the diffusion layer 14, but the *subsequently grown metal oxide* that is exposed to a *reducing agent* so that it can be reduced to metal layer 16. Thus, Soininen et al. *does not* teach that the diffusion layer 14 is exposed to the reducing agent, and Soininen et al. *does not* teach a preparation process that comprises exposing the *diffusion barrier* to both “an oxidant and a reducing agent,” as recited in Claim 33.

However, to facilitate prosecution, Applicants have amended Claim 33 to recite that the preparation process comprises “exposing the diffusion barrier layer to an oxidant and a reducing agent, wherein the oxidant oxidizes a portion of the diffusion barrier layer and the reducing agent reduces the oxidized portion of the diffusion barrier layer.” To the extent that the Examiner may believe that the diffusion layer 14 in Soininen et al. is also indirectly exposed to a reducing agent, Applicants submit that amended Claim 33 makes clear that a portion of *the diffusion barrier* is exposed to *both* an oxidant and a reducing agent, and further that the claimed oxidant oxidizes that portion of the diffusion barrier and the reducing agent subsequently reduces the oxidized portion of that diffusion barrier. *See, e.g.*, paragraphs [0052] to [0054] and FIG. 6 of Application. In contrast, Soininen et al. only teaches that the oxidant oxidizes the *diffusion barrier*, but that the reducing agent reduces an *overlying metal oxide* layer.

Applicants submit that Wu et al. fails to cure the above deficiencies. Wu et al. teaches the lining of a damascene opening with a diffusion layer, *depositing* a first seed layer over a diffusion barrier, and *depositing* a second seed layer over the first seed layer. (Wu et al, paragraph [0022], [0023] and [0026]). There is no teaching in Wu et al. of a preparation process comprising “exposing the diffusion barrier layer to an oxidant and a reducing agent.” Applicants also submit that none of the other cited references cure this deficiency either. Elers et al. is only cited for disclosing particular materials for the diffusion barrier layer. Aaltonen et al. is only cited for disclosing pulses of hydrogen and oxygen pulses in ALD processes. Chen et al. is only cited for disclosing electrochemical deposition of copper. There is no teaching or suggestion in any of these references of a preparation process comprising “exposing the diffusion barrier layer to an oxidant and a reducing agent.”

Thus, Applicants respectfully request withdrawal of the rejection to Claim 33, because the cited references fail to teach or suggest a method for metallizing an integrated circuit comprising, *inter alia*, “exposing the diffusion barrier layer to an oxidant and a reducing agent, wherein the oxidant oxidizes a portion of the diffusion barrier layer and the reducing agent reduces the oxidized portion of the diffusion barrier layer,” as recited in amended Claim 33.

A reason to combine Soininen et al. and Wu et al. has not been set forth

The Office Action states that Soininen et al. teaches all the limitations of Claim 33, except for “a seed layer that is different from the nucleation layer,” but that Wu et al. supplies this limitation. In particular, the Office Action states on pages 3-4 that it would have been obvious to combine the teachings of Soininen et al. and Wu et al. because they teach “substantially the same environment of a barrier layer and *two seed layers* on a substrate” (emphasis added), and that the skilled artisan would incorporate “a different material for the *first and second seed layers* of Soininen et al., since the different materials would provide a reliable bond between seed layers” (emphasis added). Applicants respectfully disagree.

First, Applicants submit that Soininen et al. *does not disclose two seed layers* as alleged. As noted above, Soininen et al. only teaches forming a diffusion layer 14, growing a metal oxide thin film over the diffusion layer 14, subsequently reducing the metal oxide to form a metal layer 16 as *a seed layer*, and finally, forming a metal fill over the *single seed layer*. (Col. 5, lines 46-

52; Col. 7, lines 21-37; FIG. 1). There is no teaching or suggestion anywhere in Soininen et al. of a ‘first and second seed layer’ as alleged in the Office Action.

Applicants further submit that the Office Action has not set forth a proper reason to combine the references. In the Court’s recent decision in *KSR International Co. v. Teleflex Inc.*, 550 U.S. \_\_\_\_ (2007), the Court repeatedly emphasized the value of determining a “reason to combine” the various teachings in the art. The Court noted that “[a] patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art.” (*KSR*, Syllabus, page 4 and page 14). Thus, the Court has made it abundantly clear that some reason to combine the various elements must be present in order to establish a *prima facie* case of obviousness.

However, the only reason the Office Action provides for combining the references is that a skilled artisan would have incorporated a different material for the *first and second seed layers* of Soininen et al. “since the different materials would provide a *reliable bond between seed layers* while allowing the electrical connection between the metal interconnect and external device as taught by Wu.” (Office Action, p. 4, emphasis added). Applicants submit that since Soininen et al. only discloses the formation of *one seed layer* with no other additional overlying seed layer, the skilled artisan would not have had any reason to look further, for example to the teachings of Wu et al., to provide a “reliable bond *between seed layers*” as alleged. Since the Office Action states no other reason to combine the references to arrive at the method of Claim 33, Applicants submit that a *prima facie* case of obviousness has not been established.

Applicants also submit that none of the other cited references cure the above deficiencies. As noted above, Elers et al. is only cited for disclosing particular materials for the diffusion barrier layer. Aaltonen et al. is only cited for disclosing pulses of hydrogen and oxygen pulses in ALD processes. Chen et al. is only cited for disclosing electrochemical deposition of copper. There is no teaching or suggestion in any of these references of “depositing a conductor over the nucleation layer to form a seed layer that is different from the nucleation layer after the preparation process is complete,” as recited in Claim 33.

Thus, Applicants respect withdrawal of the rejection to Claim 33, because the cited references fail to teach or suggest a method for metallizing an integrated circuit comprising, *inter*

Application No.: 10/810,415  
Serial No.: March 25, 2004

*alia*, "depositing a conductor over the nucleation layer to form a seed layer that is different from the nucleation layer after the preparation process is complete," as recited.

For at least the forgoing reasons, Applicants respectfully request withdrawal of the rejection to independent Claim 33, and Claims 34-36, 38-47, 51-52 and 63-66, which depend therefrom.

Application No.: 10/810,415  
Serial No.: March 25, 2004

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, the Applicants are not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. The Applicants reserve the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that the Applicants have made any disclaimers or disavowals of any subject matter supported by the present application.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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